Journal of Crop and Weed 7(1):120-123 (2011)

An integrated approach to manage weeds in groundnut-upland rice-potato cropping sequence

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Received: 16.03.2011, Revised: 12.05.2011, Accepted: 15.05.2011

ABSTRACT

A field experiment was carried out to standardize the agro techniques for controlling the weeds; study the effect of different weed control measures on the yield of the crops in the sequence; analyse the magnitude of losses due to weed infestation and cost effectiveness of different weed control measures in groundnut-upland rice –potato cropping sequence, in the Gangetic Alluvium soil (Entisol) having sandy clay loam texture with moderate soil fertility status at C Block Farm (22^{0}5` N latitude and 89^0 E longitude with an latitude of 9.75 meters above the mean sea level) of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia West Bengal. The experiment was laid out in RBD with nine treatments replicated thrice. In groundnut the pod yield vis-à-vis return per rupee invested were maximum under the treatment T_3 though economically the treatment T_8 and T_9 were almost at par with it. In case of rice though the yield was maximum under the treatment comprising of two hand weeding at 20 and 40 DAS (T_3). However, this cumbersome, laborious, time consuming and costly method could easily be replaced by the application of Oxadiargyl @100 g a.i. per ha, most economically. In case of potato the tuber yield and return per rupee invested were maximum under the treatment T_3followed by the treatment T_8 and T_9

Key words: Groundnut- upland rice – potato sequence, integrated approach, weed management

Our country is endowed with an enormous range of agro-climates and soil types to support diversified agriculture and multidisciplinary farming system. In this context intensive rather multiple cropping assumes great importance. It may be an effective tool for increasing total production from a piece of land as it increases net cropped area indirectly. Crop diversification in a cropping sequence on the same piece of land may be a very important tool in increasing per ha net production from that land. But in the era of global environmental perspective we cannot emphasize on our production need alone; we must consider the soil health to keep the sustainability of our production unaffected. Cultivation of huge nutrient mining crops like rice, potato etc may degrade our natural soil nutrient reserve. Under such a dilemma, ground nut, being a leguminous crop would be one of the best components for our cropping sequence. But, it is also important that to get some profitable return from a given cropping system, it is vital to keep the damage of the crop by various "harmful agents" below the economic threshold level (ETL). Among these agents weeds contribute a significant interference to the normal crop growth and yield. So, controlling weeds is an important thrust area of research in modern profit oriented farming. As weeds are those plants which are not desired in respect of time and place and having a tremendous propagation and dispersal potential, both preventive and curative measures should be taken. The preventive measures include some cultural and mechanical methods whereas curative measures include chemical and some sorts of mechanical methods. So, in order to get a weed free crop field, it is better to go for an integrated approach or to co-ordinate all the approaches suitable for the growers.

MATERIALS AND METHODS

A field experiment was carried out in Gangetic alluvium soil (Entisol) having sandy clay loam texture with moderate soil fertility status during two consecutive years (*rabi* 2008-09, 2009-10 and *pre-kharif* and *kharif* 2009, 2010) at C Block Farm (22^{0}5` N latitude and 89^0 E longitude with an latitude of 9.75 meters above the mean sea level) of BCKV, Kalyani, Nadia West Bengal to study the Integrated Weed Management in Groundnut-Upland Rice-Potato cropping sequence. The value of pH 6.74, Organic carbon 0.57%, Total N 0.055%, Available P_2O_5 26.29 kg ha^{-1}, Available K_2O 148.72 kg ha^{-1} were estimated by Combined glass electrode pH meter method, Walkley and Black's rapid titration method, Modified macro Kjeldahl method, Olsen's method and Flame photometer method respectively (Jackson, 1973). ICGS 44, IET 4786/ Satabdi, and Kufri Chandramukhi were the variety of groundnut, upland rice and potato respectively. The experiment was laid out in RBD with nine treatments replicated thrice. The treatment details were given below in tabular form.

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Table 1: Treatment details

Notation	Groundnut	Rice	Potato
T_1=	Un-weeded check	Un-weeded check	Un-weeded check
T_2=	HW at 20 DAS	HW at 20 DAS	HW at 20 DAP
T_3=	HW at 20 DAS and mulching	Two HW at 20 and 40 DAS	HW at 20 DAP and mulching
T_4=	Pendimethalin @1 kg a.i.ha^{-1}	Butachlor@1.5kg a.i. ha^{-1}	Metribuzin @0.60 kg a.i. ha^{-1}
T_5=	Trifluralin @1 kg a.i. ha^{-1}	Pendimethalin@1kg a.i.ha^{-1}	Quizalfop Ethyl @1kg a.i. ha^{-1}
T_6=	Alachlor @1.5 kg a.i. ha^{-1}	Oxadiargyl @100 g a.i.ha^{-1}	Pendimethalin @1.00 kg a.i.ha^{-1}
T_7=	Pendimethalin @1 kg a.i.ha^{-1}+mulching	Butachlor @ 1.5 kg a.i.ha^{-1} +one HW at 20 DAS	Metribuzin @ 0.60 kg a.i. ha^{-1}+mulching
T_8=	Trifluralin @1 kg a.i.ha^{-1} +mulching	Pendimethalin @1 kg a.i. ha^{-1}+one HW at 20 DAS	Quizalfop Ethyl @1 kg a.i. ha^{-1} + mulching,
T_9=	Alachlor @1.5 kg a.i. ha^{-1} + mulching	Oxadiargyl @ 100 g a.i. ha^{-1} +one HW at 20 DAS and	Pendimethalin @ 1.00 k g a.i. ha^{-1}+ mulching

RESULTS AND DISCUSSION

Some of the predominant weeds of groundnut were *Cyperus rotunda , Digera arvensis*; of Upland direct seeded rice were *Echinochloa colonum, E. crusgali ,Paspalum disticum* and of potato were *Fumaria paviflora, Anagalis arvensis, Chenopodium album.* In case of groundnut the pod yield vis-à-vis return per rupee invested were maximum under the treatment T_3 though economically the treatment T_8 and T_9 were almost at par with it (Table 2). So the findings of the experiment provide us with a great opportunity of using herbicides along with mulching to manage the labour crisis due to heavy engagement of labours in jute during this *pre-kharif* Groundnut season. At the same time mulching can also help in conserving soil moisture and nutrient as an important tool of resource conservation technology. The results are in agreement with the findings of Nandurdar *et al.* (2000) and Subrahmaniyan *et al.* (2008). Likewise, in case of rice though the yield was maximum under the treatment comprising of two hand weeding at 20 and 40 DAS (T_3), such cumbersome, laborious, time consuming and costly mechanical method could easily be replaced by the application of oxadiargyl @100 g a.i. ha^{-1}, most economically (Table 2). Similar result was also reported by Attlla *et al.* (2002). In case of potato the tuber yield vis-à-vis return per rupee invested were maximum under the treatment T_3. And the treatment T_8 and T_9 performed almost equally as good as the best treatment *i.e.* T_3 (Table 2). So from the point of eco-safety measures combination of hand weeding and mulching (T_3) can be judiciously recommended to the potato growers as mulching enhances tuber growth by maintaining soil health and hand weeding improves tuber growth by loosening the soil properly. The time consuming labour oriented hand weeding can be most economically replaced by using mulching along with herbicides (quizalfop ethyl or metribuzin).

It is evident from table 3 that at 60 DAS and at harvest, the best result in biomass was obtained from groundnut receiving hand weeding (HW) at 20 DAS + mulching *i.e.* T_3 (14.46 & 19.26). Upland rice receiving HW at 20 DAS + oxadiargyl @ 100 g a.i. ha^{-1} (T_9) showed the best performance and allowed the lowest weed biomass in the plot. Similar result was also observed by *Bahar et al.* (2004). At 30 & 60 DAP, potato treated with HW at 20 & 40 DAS (T_3) showed the lowest weed biomass (2.11 & 4.84) and at later stage the treatment T_7 (HW at 20 DAS + butachlor @ 1.5 kg a.i. ha^{-1}) was found to be best being, 11.05 (Table 3). The result was in parity with the findings of Shimi (2000).

The un-weeded control plot (T_1) in groundnut recorded the highest WI (28.62) where as the crop receiving trifluralin @ 1 kg ai ha^{-1} + mulching *i.e.* T_8 recorded the lowest value (9.84). This may be due to uncontrolled weed growth in un-weeded plot resulting severe weed crop competition. The present findings corroborate the earlier work made by Dutta *et al.* (2001). In upland rice, the highest weed index (47.66) was recorded from the control plot (T_1) whereas the lowest result (8.72) was associated with the treatment T_9 (HW at 20 DAS + oxadiargyl @ 100 g a.i. ha^{-1}). This result was in agreement with the findings of Pal *et al.* (2002). Potato receiving no weed control measures (T_1) recorded highest one (24.87) and the crop treated with quizalfop ethyl @1 kg a.i. ha^{-1} + mulching i.e. T_8 recorded the lowest WI value (5.52). In ground nut, the crop treated with HW at

20 DAS + mulching (T_3) showed the highest values (87.88, 76.06 & 68.10) of WCE at all the growth stages (Table 4) This may be due to the suppression of early weed growth by adoptition of hand weeding with mulching. Ghosh (2002) also found similar result with regard to the weed management in ground nut. In case of upland direct seeded rice, the treatment T_9 (HW at 20 DAS + oxadiargyl @ 100 g a.i. ha^{-1}) showed the continuous best performance at all the growth stages (Table 4). This may be due to application of oxadiargyl @ 100 g a.i. ha^{-1} as post-emergence along with hand weeding which in turn controlled the weed growth at early stage and helped the crop with maximum availability of growth factor for it's utilization. In potato the WCE at 30 DAP and 60 DAP was found to be highest (74.55%) in the treatment T_3 (HW at 20 DAP + mulching). But at later stage the treatment T_7 (metribuzin @ 0.6 kg a.i. ha^{-1} + mulching) was found to be best (61.05). This may be due to eradication of weeds by hand weeding and suppressing the same by mulching resulting high mortality of weeds. But at the later stage the weed growth was checked due to adoption of herbicides and use of mulching by their combined weed killing and weed suppressing effect. Tripathi and his coworkers (1984) also observed similar result.

Table 2: Yield of crops and economics under different weed management practices in groundnut-upland rice-potato sequence

Treatments	Groundnut		Rice		Potato	
	Pod yield (q ha^{-1})	Return ₹$^{-1}$ investment	Grain yield (q ha^{-1})	Return ₹$^{-1}$ investment	Tuber yield (t ha^{-1})	Return ₹$^{-1}$ investment
T_1	9.17	1.15	22.10	2.21	19.95	2.66
T_2	13.46	1.57	29.65	2.25	24.24	3.14
T_3	22.41	2.50	38.60	2.40	28.72	3.81
T_4	15.60	1.90	28.30	2.44	25.00	3.20
T_5	16.61	2.02	31.05	2.22	22.66	3.04
T_6	16.41	2.04	34.75	3.06	25.59	3.45
T_7	17.69	2.26	34.95	2.28	26.88	3.42
T_8	21.23	2.49	35.75	2.17	28.60	3.61
T_9	21.16	2.48	37.15	2.60	26.43	3.59
SEm (±)	**2.02**	**0.07**	**1.73**	**0.11**	**2.48**	**0.82**
LSD(0.05)	**5.47**	**0.19**	**4.96**	**0.31**	**6.44**	**0.23**

Table 3: Effect of different weed management practices on total weed biomass

Treatments	Groundnut (g m^{-2})			Rice (g m^{-2})			Potato (g m^{-2})		
	30 DAS	60 DAS	Harvest	30 DAS	60 DAS	Harvest	30 DAS	60 DAS	Harvest
T_1	38.44	48.75	53.33	70.39	106.63	149.40	8.14	16.29	26.14
T_2	28.82	34.81	42.94	49.29	91.26	98.62	4.22	11.11	18.16
T_3	6.88	14.46	19.26	18.54	50.70	54.13	2.11	4.84	14.94
T_4	19.57	36.95	31.51	52.39	72.49	101.66	4.86	6.29	16.69
T_5	29.32	31.13	39.37	49.99	61.07	95.90	3.88	9.88	13.62
T_6	18.93	36.61	40.87	47.88	67.53	81.69	6.44	12.12	19.47
T_7	16.65	28.04	28.72	56.49	49.49	18.80	3.14	8.01	11.05
T_8	23.17	24.42	33.09	29.83	45.98	60.97	4.12	5.47	12.36
T_9	16.98	19.53	26.71	18.03	30.53	37.58	4.31	9.92	16.24
SEm (±)	**1.46**	**2.87**	**1.88**	**1.55**	**5.61**	**3.96**	**0.98**	**1.89**	**1.62**
LSD(0.05)	**NS**	**8.24**	**5.63**	**5.03**	**18.32**	**12.92**	**2.65**	**5.23**	**4.69**

Table 4: Effect of different weed management practices on weed control efficiency

Treatments	Weed control efficiency (%)											
	Groundnut				Rice				Potato			
	30 DAS	60 DAS	Harvest	Weed Index	30 DAS	60 DAS	Harvest	Weed Index	30 DAS	60 DAS	Harvest	Weed Index
T_1	0.00	0.00	0.00	28.62	0.00	0.00	0.00	47.66	0.00	0.00	0.00	24.87
T_2	36.86	33.58	23.99	26.91	42.76	14.41	33.98	27.10	36.23	27.62	23.51	25.08
T_3	87.88	76.06	68.10	0.00	73.66	52.45	63.76	0.00	74.55	79.91	49.24	0.00
T_4	46.44	31.16	38.68	22.51	25.57	32.01	31.95	30.53	45.22	55.71	42.17	22.11
T_5	31.54	36.01	30.28	24.42	28.98	42.72	35.80	26.16	38.17	51.34	40.23	25.08
T_6	48.27	29.82	28.20	18.29	31.97	36.66	45.32	12.15	41.90	45.86	32.06	14.93
T_7	61.04	51.26	54.78	15.37	48.16	53.58	53.94	17.44	65.83	73.85	61.05	10.93
T_8	44.75	57.60	41.61	9.84	57.62	56.87	59.19	8.72	25.17	63.78	55.77	5.52
T_9	60.71	53.17	50.00	11.09	74.38	71.36	74.84	5.91	48.82	57.56	45.28	7.12

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